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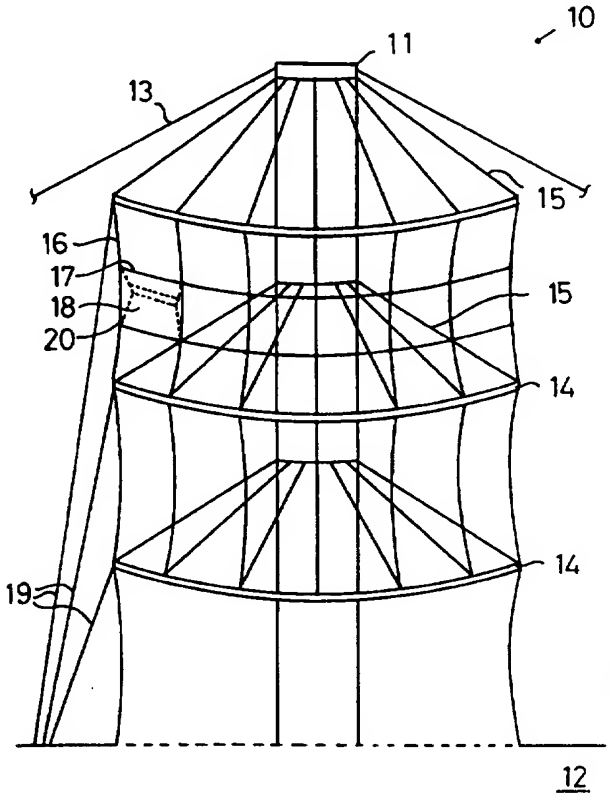
(54) Title: CHIMNEY

(57) Abstract

This invention relates to a chimney (10) constructed with parts which are separately movable inwardly of the chimney (10), as under wind pressure. The chimney (10) is constructed using a net framwork around a central column (11), the framework carrying cone shaped panels (20) which can open inwardly of the framework to allow ingress of air. The panels (20) can be lowered in high wind conditions.



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CHIMNEY

FIELD OF THE INVENTION

This invention relates to a chimney, and in particular to a chimney constructed from separate chimney units, located one above another, and to chimney units therefor.

BACKGROUND TO THE INVENTION

Chimneys are used in a variety of locations, and for a variety of applications. In particular, they may be used with a solar heat collector, the chimney containing one or more turbines to generate (electrical) power from the up-rushing, solar heated, air or other gas. Alternatively, they may be used for other types of power generation, or with desalination plants and/or as emission and exhaust devices.

Traditionally, chimneys have been constructed of brick, concrete, steel or other reinforced or substantially rigid materials. Rigid construction methods are also used. If the traditional chimneys are to be of great height and of great diameter, they are expensive to construct and to maintain. Additionally, the problems of wind resistance and aerodynamic stability in the event of strong lateral winds limit the height of such rigidly built chimneys.

The chimney units of the present invention can be modular sub-assemblies or they can be parts of the chimney which are similar to other parts - typically adjacent parts, above and below. Thus it is only necessary to describe one chimney unit, since the chimney will have many such units.

DESCRIPTION OF THE PRIOR ART

U.S. patent 3,489,077 teaches a waste discharge stack of tubular structure, buoyantly supported. The assembled chimney is held erected by a balloon, and when so erected presents a solid external surface to impinging wind. To limit the effect of impinging wind forces the chimney can be contracted in length, or collapsed, as by the use of bellows-like folds, telescoping stiff tubular sections, or hinged stiff tubular sections.

A self-supporting chimney constructed from separate inflated chimney units is known from our international application WO94/20710. The units are mounted one on top of another, each unit comprising separate segments which can flex inwardly under the action of impinging wind, whereby to reduce the lateral wind force on the chimney and to permit the impinging wind to flow into the chimney and flow upwards towards the open chimney mouth. During use it is necessary to re-inflate units from which gas has escaped.

STATEMENT OF THE INVENTION

It is the object of the present invention to provide a chimney which avoids or reduces the disadvantages of the known chimneys, so that it can withstand a lateral wind of high speeds, and so that it can sensibly be constructed to a greater height.

Thus we propose a chimney formed from separate chimney units one above another, each chimney unit having an upstanding wall comprising separate segments, characterised in that a segment includes a composite panel, the panel having a first part which is individually movable relative to the remainder of the panel inwardly of the chimney.

We also propose a chimney formed from separate chimney units, each unit comprising a plurality of panel sections, the panel sections being collapsible. Preferably all the panels of a unit are collapsible together. The panels will be selectively collapsed only under conditions of high wind speeds, for which deflection inwards of impinged panels is insufficient to maintain the wind force on the chimney below an upper pre-set limit.

Thus under normal wind conditions the panel first part can be moved inwardly of the erected chimney, and the impinging wind can then flow into the chimney and be deflected in an upwards direction, towards the open mouth of the chimney.

Our proposal has the advantage that the chimney can be lightweight. Additionally, because the panels are flexed inwardly under the influence of wind forces, and deflect the air into the chimney and upwards towards its open mouth, the chimney can withstand high lateral wind forces, and, together with its lightness, this allows a chimney to be constructed up to heights of, for example, 10,000 metres, and perhaps more.

For normal wind conditions, because an impacting lateral wind is deflected into the chimney, and upwards towards the open end of the chimney, the performance of the chimney in strong wind conditions is enhanced. Thus the chimney does not need to be disabled, by lowering of the panels, unless the wind conditions are exceptional.

The sectional construction of the chimney from separate units facilitates rapid construction. In a useful embodiment the panels are secured to a lattice surrounding a central support column, a panel and its associated supporting lattice forming a segment.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be further described, by way of example, with reference to the accompanying schematic drawings, in which:-

Fig.1 is a side sectional view of a chimney according to the invention;

Fig.2 is a perspective view of an opened panel for use with the construction of Fig.1; and

Fig.3 is a perspective view of part of a chimney with collapsible panel sections.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The chimney arrangement 10 has an annular (upwards) flow passage around a central shaft 11. Central shaft 11 is made in this embodiment of reinforced concrete, but in alternative embodiments is of steel or other strong and substantially rigid material. Shaft 11 is anchored to the ground 12 with guy ropes 13, which are made in this embodiment from steel but in an alternative embodiment of nylon or other flexible high-tension bearing material.

The guy ropes 13 extend from the top of central shaft 11; in an alternative embodiment additional guy ropes extend from various vertically spaced positions upwardly (along the erected height of) central shaft 11.

Large diameter rings 14 made in this embodiment of very lightweight plastic material (but in alternative embodiments of composite fibre, steel, or of hollow steel tubes) are

suspended by support ropes or wires 15 from the central shaft 11 at various heights, in this embodiment from a position adjacent the top of central shaft 11 down to a position near the bottom of the shaft, and the rings and ropes help form an outer framework for chimney 10.

In this embodiment the large diameter rings 14 are also anchored to the ground 12, with guy ropes 19 tightened to inhibit movement of rings 14 relative to the central shaft 11. In an alternative embodiment rings 14 each have an inner support ring which closely surrounds central shaft 11 and helps maintain (outer) ring 14 in relative position spaced from central shaft 11.

The large diameter rings 14 are interconnected with vertical wires 16, or as in this embodiment of light, but strong nylon cord, but in alternative embodiments of steel or aluminium cables. Thus the rings each hang from the ring above, with the uppermost ring supported by the central shaft 11. However the rings can also or alternatively be individually supported from central shaft 11 by wires 15, and in an alternative embodiment by rigid struts.

The vertical wires 16 (and thus the large diameter rings 14) are interconnected by horizontal cross-wires 17 to form an open-mesh net, with net openings 18; in this embodiment the net openings are 1m square.

The net openings 18 are covered by cone shaped panels 20, shaped as seen in Fig.2. The panels are secured around their aperture 21 to the mesh 16,17, but otherwise the remainder of the panel (the first part of the panel) can be blown by impinging wind further inwards of the mesh.

The panels 20 are made of very lightweight, long-lasting material, in this embodiment of nylon, but in alternative embodiments of selected plastic, composite fibre, or cloth

materials. The material is coated and treated to withstand ultra-violet and sunlight degradation and harsh climatic conditions.

The cone shaped panels 20 consist of a large aperture 21 (in this embodiment a square aperture 1m by 1m) to be secured to the wires 16,17 defining a mesh opening and to fit into a respective opening 18 of the net. Large panel aperture 21 is thus in the position of use at the panel end which faces outwardly of the chimney 10; the panel also has a somewhat smaller second aperture 22 (in this embodiment 0.75 long by a width tapering from 0.75m) at its other or inner end. The second and smaller aperture 22 is positioned in its position of use at the upper or top side of the cone shaped panel 20, as seen in Fig.2.

Each cone shaped panel 20 is thus constructed so that wind entering through the large aperture 21 will be deflected inwardly and upwardly into the chimney 10, along and perhaps also spiralling upwardly around central column or support 11; in a preferred embodiment there will be a wind deflection in the panel exceeding an angle of 30^0. With the cone extended horizontally, and with fresh wind entering the chimney from aperture 22, there will be minimum risk of air upflowing from below leaking out of an aperture 22.

However, when there is a small or insignificant wind blowing against the side of the chimney, the natural updraft in the chimney can be expected to cause the cone-shaped panels, in particular the edge 23, to be pushed upwardly, so that the sheet 24 substantially or completely closes off the large opening 21, preventing the escape of the updraft air laterally from the chimney.

In an alternative embodiment, each cone shaped panel 20 may be constructed in such a way that a stronger wind will blow straight in through large aperture 21 and exit through

second aperture 22 into the chimney 10 without being deflected or without being substantially deflected.

In a further alternative embodiment, but less preferred to that set out below for dealing with the unusual very high wind speeds, a very strong wind can blow in laterally from one side of chimney 10 through one or more of the large apertures 21, and through second aperture 22 and travel across the inside of chimney 10 and exit through the opposite wall areas (at an approximately opposite position as some deflection will take place); the wind will turn the opposite panel inside out, so that the second aperture of the opposite panel is outside the net of the chimney wires 16,17; the wind enters the large opening of the opposite panel and exits through the second aperture 22 on the (approximate) opposite side of chimney 10.

In an alternative embodiment, to prevent the panels being turned inside out (by a very strong wind), for instance with the panels being collapsed as described below, a net with a smaller mesh size than that of the net openings 18 (in a preferred embodiment with net with 7.5 cm square openings) is fixed outwardly of each respective net opening 18. The net will thus prevent a cone shaped panel 20 being blown or sucked out of or away from the chimney 10.

Cone shaped panels are a preferred embodiment for the invention, but the panels could be of any shape which provides a wind inlet (from outside the chimney) and wind outlet (to inside the rings and lattice framework); and with connection means positioned to allow a panel to hang down (or up) so as to cover the net openings 18 (in the absence of strong outside wind forces, to minimise leakage of wind already in the chimney). In the no-wind or light-wind condition the panels can hang down, so that together they act to form an outer curtain wall for the chimney 10 (the sheet 25 covering the opening 21).

The large diameter rings form the circumference of the chimney, along with the vertical wires and cross-wires. The cone shaped panels remain substantially closed unless a external wind force bears on the chimney. The second aperture has an expandable opening, adopting its maximum (opened) position at a selected impinging wind force.

In an alternative embodiment, an inner tube (not shown), of a diameter larger that the central shaft 11 but smaller than that of the large diameter rings 14, can be suspended in the chimney, around the chimney shaft 11, the inner tube being of a flexible material, or in an alternative embodiment of a semi-rigid material. The inner tube has openings corresponding to (preferably aligned with) the panel aperture 22, whereby to deflect impinging wind so that it will flow upwardly within the inner tube and thus within the chimney. In an alternative embodiment the inner tube openings are directly connected to the respective panel apertures 22.

There will usually be fans and wind turbines located at the bottom end of the chimney, in known fashion, suitably to use the wind in the chimney to generate electrical energy.

Other means than self-opening by wind pressure can be used in particular circumstances to open some or all of the apertures in the cone shaped panels, such as mechanical, gravitational, magnetic, electrical, or electronic means. This "other means" might be used to create exit passageways in very high wind conditions for excess air in the chimney, usually from the lee side of the chimney.

In the alternative arrangement of Fig.3, if the chimney experiences a cross-wind greater than a pre-set speed, requiring the chimney to withstand greater than a predetermined acceptable force, each chimney panel section

40 can be wound down i.e. it can be collapsed as shown for panel section 40a of the upper chimney unit, to a position where it is only minimally subject to the cross-wind force, and there possibly be stowed away. When the wind speeds fall, the panel section 40a can be raised back to the operating position as shown for the lower chimney unit.

The circular rings 34 are suspended from the central shaft 31 by suspension cables 35 in similar fashion to those of the embodiment of Fig.1, and in this embodiment are fixed to the central shaft by spokes 32. Interconnected cable mesh wires 36 and 37 are used to connect the circular rings in sections to each other. Collapsible cylindrical panel sections 40 provide a wall or cladding spaced from the central shaft 31, in this embodiment being however mounted inside the cable mesh wires 36,37, and they are respectively connected to the circular rings from the topmost ring downwards.

The panel sections are mounted on pulleys 41, in this embodiment at the top of each section (though only shown at the top of the top-most section in the drawings, for clarity), but in alternative embodiments at the bottom or at both top and bottom.

The panel sections are in this embodiment fitted with electronic sensors 42 adapted to sense the wind speed and thus the wind force, and to generate a signal when the force exceeds a pre-set value; in an alternative embodiment there are sensors only for some of the panels, preferably those of the topmost chimney unit. In a less preferred alternative embodiment for day-time chimney usage, the wind speed is measured only when weather conditions dictate, and by ground based means such as the release and observation of weather balloons.

In the preferred embodiment the signal from one or more of the sensors 42 triggers a response mechanism 43 which will react to excess wind speeds to wind down the panel sections, usefully in concertina fashion. In an alternative embodiment the response mechanism reacts to a ground based signal, which may itself have been instigated by a signal from a sensor 42.

With the membranes lowered, the strong winds will pass through the cable mesh 36,37 and pass around the central shaft 31, by-passing the circular rings 34 and the spokes 32, all of which present only a relatively small surface area so that the structure can be economically designed to stand strong winds, being disabled only for the very strongest winds.

The panel sections 40 may be wound down together, or one section at a time, all sections being left in place as long as possible even in conditions of increasing wind speeds. Alternatively, as the wind speed increases towards the danger level, more sections can progressively be lowered to the position shown for section 40a.

An advantage of this collapsible arrangement is that the erected chimney can be designed to withstand the normal maximum wind speeds, so that the partial or full collapsing procedure is only activated for the exceptional wind speeds which occur perhaps two or three times a year. Thus it is not necessary for instance that the chimney be designed to withstand when erected a cyclonic wind speed of 150 km/hr, which might occur for perhaps 20 hours each year, when for the rest of the year it need only withstand a lesser maximum wind speed of perhaps 100 km/hr or 60 km/hr, with therefore a great saving in construction cost yet allowing full erected chimney operation for over 99% of the hours available throughout the year.

The erection of the panels from the 40a position can also be made automatic, when the sensors indicate that the wind speed has dropped to an safe level.

The minimum wind speed we foresee for sensor activation of the winding-down gear would be 29 Km/hr. This relatively low threshold might be set when the material of the panel sections is expensive to replace, with therefore care being necessary if panel life is to be acceptable.

In an alternative embodiment the panels can be collapsed to ground level, which may be advantageous despite the extra time required for the occasional collapse and re-erection, if frequent panel replacement is contemplated. With all the panel sections collapsed, the chimney operation is shut down.

The chimney may have a diameter of 10m or more, and a height from 20m to 5000m.

The main advantages of these embodiments, in relation to comparable chimneys of conventional construction, is :-

(a) that they offer lower resistance to impinging winds, and can therefore be made of lightweight, flexible but strong long-lasting materials;

(b) that the construction methods and tasks can be greatly simplified;

(c) that the costs of construction can be reduced;

(d) that the construction permits excellent protection and stability against earthquakes etc. This is a very

important consideration as very tall structures may be required in some circumstances.

In addition the chimney can be connected to a power plant utilising the updraft to produce electricity for the national grid or for large factories, and can be installed in remote locations.

CLAIMS

1. A chimney (10,30) formed from separate chimney units (3) one above another, each chimney unit (3) having an upstanding wall comprising separate segments (12), characterised in that a segment comprises a panel, the panel having a first part which is individually movable relative to the remainder of the panel inwardly of the chimney.

2. A chimney according to claim 1 characterised in that the panel is supported by a mesh, the mesh comprising upwardly extending and laterally extending wires joined at their interconnections to form openings traversed by the panel, the panel being connected to said wires.

3. A chimney according to claim 2 characterised in that said upwardly extending wires interconnect rings suspended from and encircling a central shaft whereby to form a framework for the chimney, said framework being inwardly covered by a plurality of said panels.

4. A chimney according to claim 1 characterised in that each panel is protected by a fine gauze net located outwardly of the panel, whereby to prevent movement of the said part of the panel outwardly of the chimney.

5. A chimney according to claim 1 characterised in that an outward surface of each panel is coated with a material inhibiting degradation of the panel by ultraviolet radiation.

6. A chimney according to claim 1 characterised in that the panel has a first aperture and a second aperture, the second aperture being open upwardly of the chimney when the said part is moved inwardly of the chimney,

the first aperture providing an air inlet from outside the chimney.

7. A chimney according to claim 1 characterised in that the panel is cone-shaped in its extended condition when said part has moved inwardly of the chimney.

8. A chimney according to claim 1 characterised in that an inner tube is suspended within the chimney, the inner tube having an opening in communication with a panels to receive wind impinging on the panel.

9. A chimney according to claim 1 characterised in that means (41,43) are provided for the wall of one or more of the chimney units (3) to be collapsed for specific periods to reduce the wind load on the chimney.

10. A chimney according to claim 9 characterised in that the means (41,43) are also adapted to move the wall from its collapsed condition to its upstanding condition in suitable wind conditions.

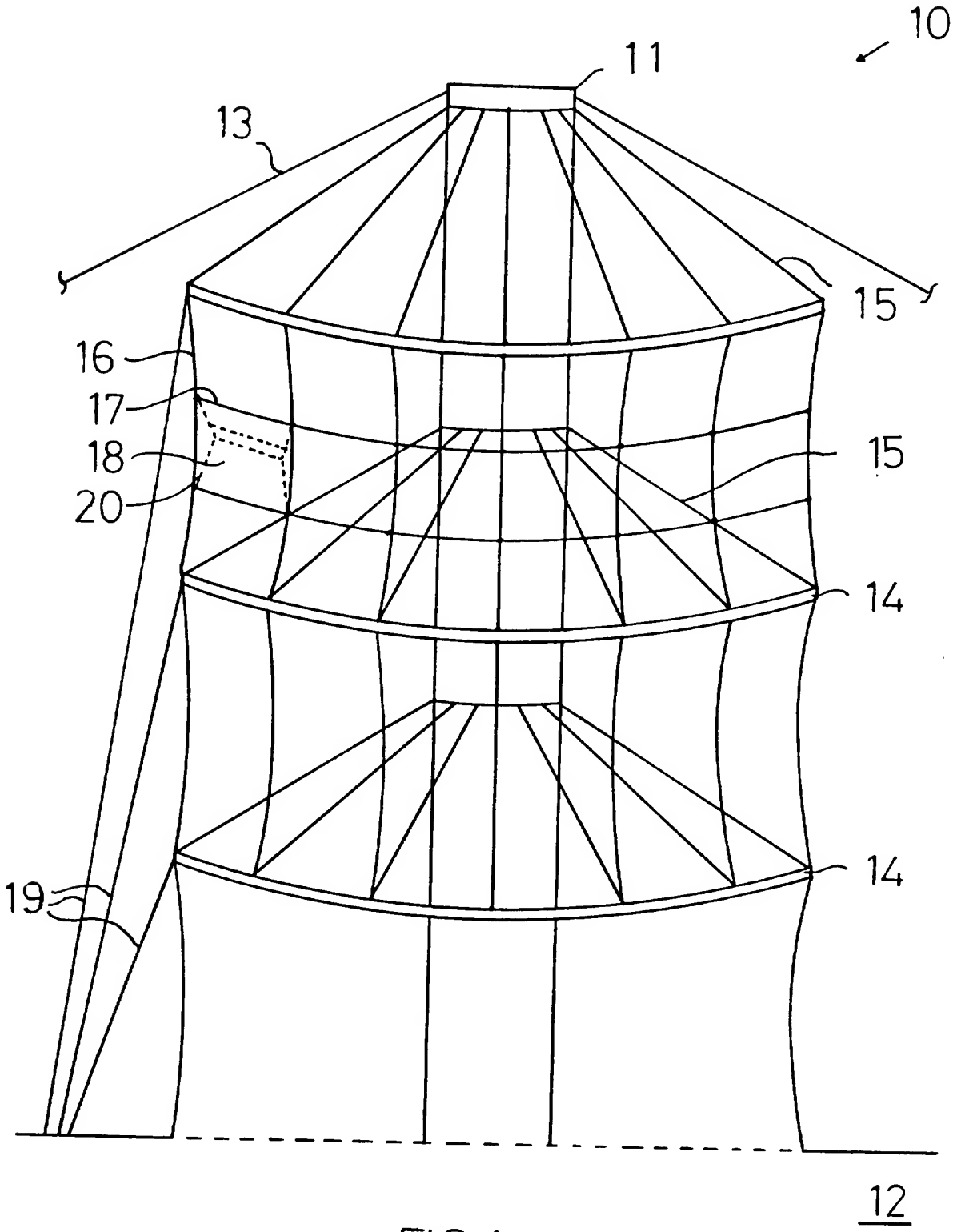

FIG 1

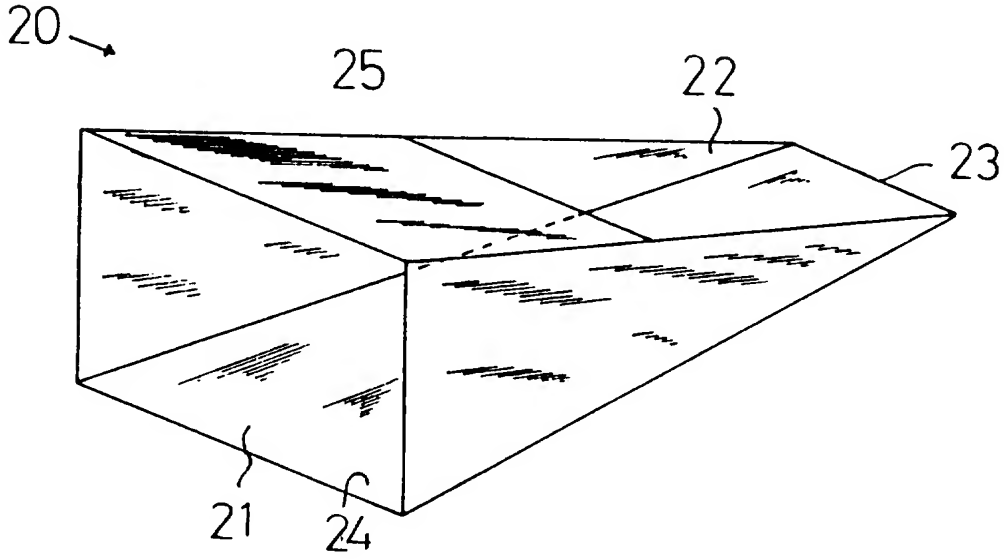

FIG 2

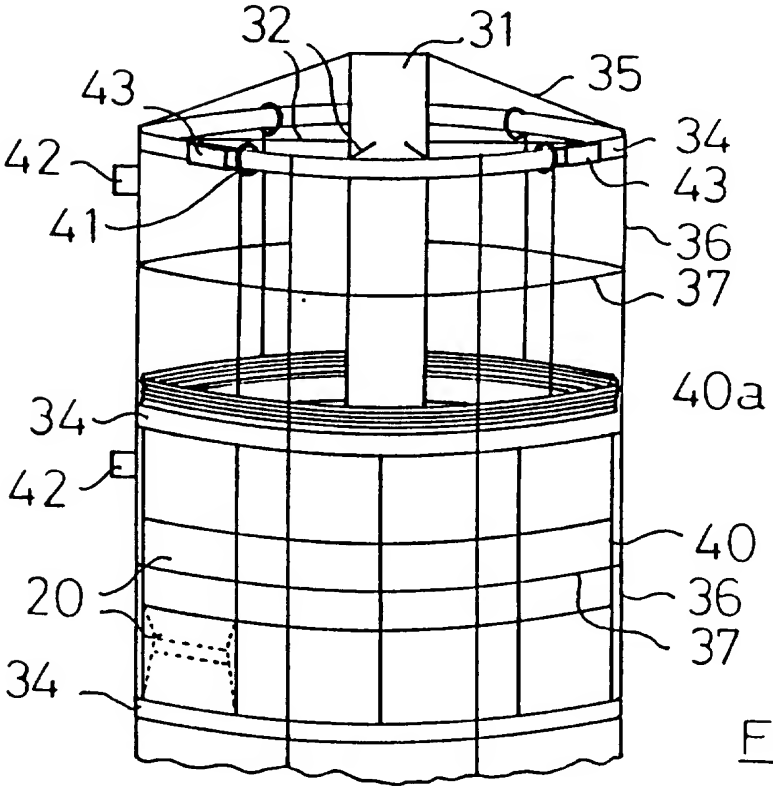

FIG 3

INTERNATIONAL SEARCH REPORT

Inte[illegible]nal Application No
PCT/IB 95/00586

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 E04H12/28

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 E04H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	FR-A-2 472 154 (METALLIQUES CIE FSE ENTREPRISE) 26 June 1981 see page 6, line 7 - page 7, line 24; figure 1 ---	1-3
A	US-A-3 994 108 (JOHNSON ROY W P) 30 November 1976 see column 3, line 47 - column 4, line 64; figure 1 ---	1-3
A	EP-A-0 034 541 (ELECTRICITE DE FRANCE) 26 August 1981 see page 7, line 17 - page 9, line 21; figures 1,2 --- -/--	1-3

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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1

Date of the actual completion of the international search	Date of mailing of the international search report
30 October 1995	15. 11. 95

Name and mailing address of the ISA	Authorized officer
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INTERNATIONAL SEARCH REPORT

Inte onal Application No
PCT/IB 95/00586

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE-A-26 40 177 (H. SONNENSCHEIN) 16 March 1978 see page 10, paragraph 7 see page 13, paragraph 2 - paragraph 3; figures ---	1,6,9,10
A	FR-A-2 222 516 (USS ENG & CONSULT) 18 October 1974 -----	

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/IB 95/00586

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
FR-A-2472154	26-06-81	NONE		
US-A-3994108	30-11-76	US-A-	4050214	27-09-77
EP-A-0034541	26-08-81	FR-A-	2476190	21-08-81
		US-A-	4520600	04-06-85
DE-A-2640177	16-03-78	NONE		
FR-A-2222516	18-10-74	BE-A-	812452	18-09-74
		DE-A-	2413428	03-10-74
		JP-A-	49128340	09-12-74

DERWENT-ACC-NO: 1996-129455

DERWENT-WEEK: 199613

TITLE: Tall chimney construction for deflecting lateral wind forces upwards has central stayed rigid column supporting surrounding net framework clad with cone-shaped panels which open inwardly under wind pressure

INVENTOR: SENANAYAKE D R

PATENT-ASSIGNEE: SENANAYAKE D R[SENAI]

PRIORITY-DATA: 1994LK-010687 (July 29, 1994)

PATENT-FAMILY:

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WO 9604443 A1	February 15, 1996	EN

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APPLICATION-DATA:

PUB-NO	APPL-DESCRIPTOR	APPL-NO	APPL-DATE
WO1996004443A1	N/A	1995WO-IB00586	July 25, 1995

INT-CL-CURRENT:

TYPE	**IPC DATE**
CIPS	E04H12/28 20060101

ABSTRACTED-PUB-NO: WO 9604443 A1

BASIC-ABSTRACT:

The chimney structure (10) has a central rigid column (11), stayed (13) at one or more levels. Large dia. rings (14) of lightweight plastics or metal are supported on ropes (15) from the column (11), and guyed (19) to the ground. Vertical and horizontal wires (16,17) form a network of typically 1 m squares.

Cone-shaped panels (20) of flexible material have a large 1 x 1 m entry end (21), and are fixed in each square of the wire network. In a light wind, the natural updraught in the chimney turns the panels up to close the net openings. Increased wind force opens the panels inwards, delivering air up the chimney via opening (22).

USE/ADVANTAGE - For solar heat collection chimneys generating upward draft for driving turbines, and other types of emission and exhaust devices. Contributes to aerodynamic stability and efficiency of chimney. Higher structures are possible.

CHOSEN-DRAWING: Dwg.1/3

TITLE-TERMS: TALL CHIMNEY CONSTRUCTION DEFLECT LATERAL WIND FORCE UP CENTRAL STAY RIGID COLUMN SUPPORT SURROUND NET FRAMEWORK CLAD CONE SHAPE PANEL OPEN INWARD PRESSURE

DERWENT-CLASS: Q46

SECONDARY-ACC-NO:

Non-CPI Secondary Accession Numbers: 1996-108753